patterning methods described above, such as those described in connection with via formation for cross-layer interconnects. In certain other fabrication techniques, the microfluidic channel **1160** is first patterned using any of the patterning methods described above, and then filled with a sacrificial material. This is beneficial when a subsequent layer of components is to be disposed above the layer **1110**, since, as mentioned above, in certain techniques the encapsulating material for the subsequent layer is flowed over the layer **1110** and would otherwise flow into the microfluidic channel **1160**. After forming the subsequent layer, the manufacturer can chemically dissolve the sacrificial material from the microfluidic channel **1160**.

[0087] In certain embodiments, ambient air flows through the microfluidic channel **1160** to serve as the convection medium. In others, a manufacturer fills the microfluidic channel **1160** with a liquid, such as sodium and/or potassium. The manufacturer may fill the microfluidic channels with a cryogenic coolant such as liquid helium or liquid nitrogen, although these materials can be included in vapor phase as well. Other exemplary materials for use within the microfluidic channel **1160** include ammonia, water, acetone, and/or methanol.

[0088] In still other embodiments, the manufacturer deposits a nanocomposite material within the microfluidic channel **1160**. The nanocomposite material can be a liquid, or can be a solid that is flowed into the microfluidic channel **1160** as a liquid and subsequently cured. In certain embodiments, nanoparticles are incorporated into a base material and deposited within the microfluidic channel **1160** to increase the thermal conductivity of the base material. Exemplary nanoparticle materials include metallic nanoparticles, carbon nanotubes, and/or ceramic nanoparticles.

[0089] In various embodiments, the microfluidic channel **1160** takes on various shapes and configurations. The depicted microfluidic channel **1160** includes a plurality of extensions **1161** that interface with the metallization layer **184**. Several extensions **1161** are beneficial at least on part to provide more surface area for thermal interfacing with the component **1117**.

[0090] As mentioned above, in addition to transferring heat, microfluidic channels can transfer fluids for environmental sampling. By way of example, the depicted component **1119** is a biochemical sensor, and microfluidic channels **1188** and **1190** transport fluids to the component **1119** for sampling, analysis, and processing. The manufacturer forms microfluidic channels **1188** and **1190** using any of the patterning techniques described herein.

[0091] In one exemplary use, a fluid sample is provided to the component **1119** via channels **1188** and **1190**. The component **1119** is a sensor that detects the presence of one or more preselected chemical compositions within the fluid sample. The component **1119** may include wireless communication capabilities to transmit the detection results to a remote location, or may couple to an optical waveguide (to be discussed in more detail below) to optically communicate the detection results to another subsystem component or to a remote location external to device **1100**. In addition to fluid sample acquisition, microfluidic channels and related structures can be used for fluid flow control, extraction, filtration and loading.

[0092] Microfluidic channels for transporting samples can also take on other shapes, sizes, and configurations. For example, microfluidic channels configured like microfluidic channel **1160** can be used to transport fluid samples. In still other embodiments, microfluidic channels transport samples among components, such as from one of the components **1112-1119** to one or more of the components **1112-1119**.

[0093] FIG. **16** shows a close-up view of a third portion of the device **1100** of FIG. **12** and shows an element for routing optical signals, according to an illustrative embodiment of the invention. More particularly, the device **1100** includes an optical waveguide **1162**. The optical waveguide transmits optical communication signals to other components within the device **1100**, or to another component external to the device **1100**. The optical waveguide includes a core **1196** through which the optical signals transmit, and a cladding **1198** for reflecting the optical signals and allowing total internal reflection within the optical waveguide **1162**. In the depicted embodiment, the core **1196** comprises the same material as the encapsulating layer **1111**, which as mentioned above is transparent to light at wavelengths suitable for optical communication. In certain embodiments, the cladding **1198** is formed by selectively removing portions of the encapsulating layer **1111** that surround the region of the encapsulating layer **1111** that is to be the core **1196**. The cladding **1198** may simply be the selectively removed portions; ambient air that flows into the selectively removed portion may have a sufficiently low refractive index so as to allow for total internal reflection. In other embodiments, the selectively removed portions are filled with a material, such as a polymer (e.g., benzocyclobutene). Thus, the optical waveguide **162** may include a polymer core surrounded by a polymer cladding.

[0094] In addition to optical waveguides, the device **1100** may include other structures for routing optical signals. By way of example, a manufacturer can fabricate and orient mirrors within the device **1100** at selected angles (e.g., 45 degree angles or 90 degree angles) to reflect optical signals in accordance with a desired signal path. In one exemplary technique, the manufacturer patterns walls, using any of the patterning techniques described herein, and coats the walls with a reflective material such as gold. Additionally, or alternatively, the manufacturer may deposit anti-reflective walls or films to avoid signal loss or cross-talk among signals. For example, the manufacturer may deposit films of titanium dioxide or silicon dioxide with thicknesses of about one quarter-wavelength.

[0095] In addition to fabricating walls or films for routing and processing optical signals, the manufacturer may also incorporate nanoparticles or nanoporous structures within the device. For example, the manufacturer can form optical filters by incorporating nanoparticles or nanoporous structures in certain regions of the encapsulating layers **1111**, **1109**, **1107**, and **1105** of the device **1100** to selectively absorb certain wavelengths of light. Exemplary materials for the nanoparticles include colloidal dyes, such as metal selenides, which can have high extinction coefficients to produce sharp absorption transitions. The manufacturer can also introduce pigments and/or color centers to control the optical properties by allowing the encapsulating layers to either absorb, transmit, reflect, scatter and/or diffract light in a predetermined fashion. Exemplary methods by which the manufacturer can introduce nanopores into the encapsulating layer include ultraviolet crosslinking, co-polymerization of multiple species, or by use of porogens. The manufacturer can also fabricate pores in the integrated circuit material using methods such as chemical etching, electrochemical